may all result from the increased activity of the endothelium. It will be remembered that in pure forms of diffuse hyperplastic sclerosis—and in speaking of "pure" forms of diffuse hyperplastic sclerosis I mean to exclude those cases in which senile arterio-sclerosis complicates the picture—fatty degeneration is confined to the terminal arterioles of the kidney and the smaller vessels in other organs. The presence of fatty change in these vessels will be referred to later, but the point that I would make now is the absence of any change that is beyond doubt degenerative in the vessels of second size—that is, the parent vessels of those affected by fatty change.

In addition to the thickening of the intima there is sometimes hypertrophy of the media in diffuse hyperplastic sclerosis. This is the only change in the middle coat, pathological changes being characteristically absent. The medial hypertrophy cannot otherwise be regarded than as a physiological response to the increased blood pressure that is present in the majority of cases of diffuse hyperplastic sclerosis. I have previously called attention to the fact that diffuse hyperplastic sclerosis of limited extent may be found after death in bodies in which the heart is not increased above 15 oz. in weight, and in which the blood pressure during life was below 180 mm. Hg. Hypertrophy of the media is not evident in these cases. There are also cases of diffuse hyperplastic sclerosis in older cases in which fatty degeneration of the media occurs and the media appears stretched in section and apparently thinner than expected in a normal artery of the same size. I have not made exact comparison in these cases, and can only express the opinion from my observations that medial hypertrophy is a common accompaniment of marked cases of diffuse hyperplastic sclerosis, and that it is present in cases in which there was a definitely raised blood pressure during life or marked hypertrophy of the left ventricle after death, though there are slighter cases of diffuse hyperplastic sclerosis in which no medial hypertrophy occurs. This medial hypertrophy is neither the essential element nor a constant feature of diffuse hyperplastic sclerosis. It is possible that the raised blood pressure precedes the vascular lesion in some cases, and it may be, therefore, that medial hypertrophy precedes intimal thickening under these conditions; in any case the medial hypertrophy is frequently so pronounced that it is regarded by some observers as the essential element in this form of arterio-sclerosis.[12]

Gull and Sutton emphasized the thickening of the adventitia in arterio-capillary fibrosis. This is present in some cases, and I have noticed it in the renal vessels and perhaps also in the spleen. It is difficult to distinguish between an increase in the adventitia and an increase in the perivascular connective tissue which is present in considerable quantity in both these organs. It has escaped my observation in other organs of the body, and needs closer study than I have given it.

Conclusion.

The main feature of diffuse hyperplastic sclerosis is a thickening of the intima, accompanied sometimes by hypertrophy of the media. The intimal changes are the essential lesion. Activity of the endothelial cells is largely responsible for the intimal thickening. In this thickening the process of degeneration plays a secondary part; it is only certainly present in the terminal arterioles of the kidney and the smallest vessels of the other organs. The characteristic feature of the lesion is an intense tissue activity, which is the very antithesis of a process of decay. The nature of the process concerned in the production of this lesion will be considered in the next lecture.

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An Address
ON
TREPHINATION OF THE LIVING HUMAN SKULL IN PREHISTORIC TIMES.*

BY
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[*With Special Plate.*]

SIXTY years ago not even the most eminent scientist in Europe was aware of the fact that, in prehistoric times, our primitive ancestors used to trephine the living skulls of their fellow tribesmen with implements made of stone. The knowledge of this was rendered possible by a discovery made by a general medical practitioner. And here I should like to say that such of you as are about to enter general practice will find, I think, this branch of our profession of a peculiarly satisfying nature, in that not only does it have for its aim the carrying out of ethical ideals by sound practical methods, but there is scope, at leisure moments, for the study of those wider interests that do not actually belong to our profession, but which are stimulated by the atmosphere created by our education, trend of thought, and environment.

Prunières, a general practitioner of Marvejols in the department of La Lozère, France, was a man who spent much of his spare time in antiquarian research. While examining a large dolmen, near Aiguières, in 1865, he discovered a skull with a curious hole in it. The hole had smooth, shelving edges which looked as if they had been polished. Prunières was puzzled as to the nature of this hole and came to the conclusion that, finding the skull in a dolmen, it had belonged to a Neolithic savage and had been converted into a drinking cup, a custom which not infrequently exists among savage tribes, and that this smooth-faced hole had been specially designed for the application of the lips. Now these dolmens were constructed during the *third* or Carnac stage of the Neolithic period, which ended in north-western Europe about two thousand years before the Christian era. The whole of the Neolithic period is computed to have lasted some twenty thousand years, the third and last division probably occupying from four to six thousand years, so that the age of these dolmens may be estimated as being not less than four and even as much as eight to ten thousand years old—the last word in these megalithic buildings being that magnificent pile known as Stonehenge, which was erected at the beginning of the Bronze Age.

Prunières was not correct in his surmise about the drinking cup. To Broca belongs the credit of explaining that the smooth, polished-looking surface of the sides of the hole in this skull was due to a healing process that had taken place in a wound of the bone during life. After this first discovery many other specimens were unearthed from the dolmens existing in those regions, so many, indeed, as to compel one to believe that, during the latter part of the Neolithic period in France, a fetish of a most extraordinary kind was prevalent among the inhabitants, and this fetish consisted in trephining the healthy human skull for some purpose of a superstitious nature, for none of the skulls showed any sign of either fracture or disease.

And now comes the point when it might very reasonably be asked, How can you definitely prove that these holes, which we now know were made during life, were the result of an operation, deliberately planned and carried out by Neolithic man? Is not this suggestion merely guesswork? Broca, having found out all he could from the nature of the specimen itself, and from the place where it was found, and the associations, turned his eyes in another direction.

Here it may be explained that all primitive tribes, on their way upward from savagery to civilization, pass through the same phases. Every nation starts with its so-called "Stone Age," when the chief material used for the making of their implements is stone. Wood, slate, shell, bone, and teeth are also used during this period. When culture has proceeded farther, metals are discovered, the first being the more malleable ones—copper and tin. By accident or experiment they find that a harder and much more serviceable metal is obtained by blending these two metals by heat, bronze being the outcome—thus the Bronze Age. When iron is discovered a stupendous advance has been made, and the early Iron Age

* Given before the Listerian Society of King's College Hospital on January 17th, 1923.

of any tribe denotes that great progress has been effected by that tribe. My point in mentioning this is to demonstrate that if only we study the life and customs of those tribes who are still going through their age of stone culture we are able, by analogy, to explain what our own ancestors did when they were passing through this early stage of evolution.

Information had been brought by travellers from certain of the South Pacific islands that the natives there actually performed this operation, at that time, on their living comrades with implements made of obsidian, shell, or shark's teeth. Since the white trader had visited those islands and introduced glass bottles—unfortunately usually in the form of whisky receptacles—the natives had manufactured implements from this glass and used these in preference to those of obsidian formerly employed. Broca had heard tales of this, and he actually made an experiment on a dead infant's skull with a piece of sharp-edged glass, and found that a hole could be made quite quickly and easily by its means. Broca had, however, only been imperfectly informed, as he came to the conclusion that all these trephine holes, in the many specimens found in France, had been made when the subjects were infants. He had not been told and he did not believe that the operation was actually performed during life on adults.

Experiments to Demonstrate Methods of Primitive Trephination.

Ten years ago, in order to get a correct and practical understanding of how primitive man (Neolithic and Modern) performed this operation, I began a series of some fifty experiments on both recent and dry human skulls with all the primitive implements that have been used for the purpose—namely, flint, obsidian, shark's teeth, shell, glass, and even slate. The only material likely to have been used in north-western Europe was stone, and the kind of stone best suited for the purpose is flint. Flint is, as you are well aware, of sedimentary formation, and it possesses the power when force is brought to bear upon it in a certain way of being split into flakes. These flakes can be made, according to the skill of the knapper, with sharp points and edges, and make excellent knives, saws, scrapers, and borers, such as would be required in any primitive household. Neolithic man also constructed most exquisitely shaped arrow-heads, spear-heads, and javelin-heads, for defence of the home and offence in the hunting and fighting field.

With these crude implements at his disposal Neolithic man, in different parts of the world, conducted this somewhat hazardous operation without anaesthetics, without antiseptics, and with dressings which would have shocked the susceptibilities of any member of the Listerian Society. And yet with all these drawbacks he got, like the present-day quack, amazing successes. I make out there were four principal methods by which he performed this operation—namely: (1) by scraping the bone (Figs. 1 and 2); (2) by boring a circle of holes and sawing the intervening spaces (Figs. 3, 4, and 5); (3) by furrowing the bone by the push-plough method (Figs. 6, 7, 8, 9, 10, and (?) 11); (4) by sawing out a quadrilateral button of bone (Figs. 12 and 13).

1. *Scraping.*

Whether the scraping be done by flint flakes, sharp-edged pieces of obsidian, or pieces of strong sharp shell, such as are found on the shores of the South Pacific islands, the principle and method of procedure are precisely the same. For scraping a hole in bone, metal not being considered, there can be no better natural implement than a well flaked piece of flint. Where flint cannot be obtained, as in volcanic regions, obsidian makes a good substitute. Obsidian is a natural volcanic glass and can be flaked in the same way as flint by a sharp, well directed blow. The obsidian I used came from the Lipari Islands, north of Sicily. Contrasting these two substances I would give flint the first place. A hard, sharp edge can be obtained in flint, which is more resistant to counter-pressure than is obsidian. Obsidian, like glass, can give an even sharper edge than flint, but it is much more brittle and the operator stands in some danger as regards his eyes, from the sharp spicules that fly in every direction. I may recall that while flint is a siliceous sedimentary deposit, obsidian is of igneous formation; both flint and obsidian, when freshly flaked, are excellent substances for surgical purposes. Their newly fractured surfaces, which are smooth—and in this respect obsidian would take pre-eminence—are aseptic, and this is a point of great practical value of which the primitive operator stood in blissful ignorance. It surprised me at first, in no small measure, to find how cleanly and easily a flint knife could cut through the scalp, and obsidian I found equally as good if not better. At the present day the natives of the Andaman Islands shave their heads with obsidian knives. The method I employed for scraping the trephine-hole with both flint and obsidian was the following. Having made a V- or Y-shaped incision in the scalp, as is done by the primitive Melanesians, over the selected site of the operation, I scraped as nearly as possible along a single line on the bone with a flint flake, which I held between the thumb and forefinger of my right hand. [Although Sir John Evans believed that our Neolithic ancestors used to haft some of these small flakes, I am convinced that no hafted implement was used in this case. This can be substantiated by the Melanesian method employed in these days, when the obsidian flake or piece of glass is held between the finger and thumb.] This line I gradually converted into a groove, which soon showed two more or less prominent ridges. The outer table of the skull is by no means as easy to remove in this manner as might be expected. The next step was to attack the edges of the groove with a curved movement of the scraper till a depression was produced in the bone, which gradually assumed an elliptical shape. It is now only a question of time and manipulation to convert this elliptical depression into a circular one, and thence, having penetrated the inner table of the skull, to expose the dura mater and enlarge the foramen in the bone to the size and shape required. In only one case can I remember slightly damaging the dura mater, and the reason of this was that my supply of Neolithic implements was limited and I had not to hand at the moment the particular shape I required. It must be remembered that when Neolithic man did this operation he would be bountifully supplied with probably hundreds of sharp, newly cut flakes, and immediately one became blunted, or was not to his fancy in any other way, he would naturally fling it aside and choose another. The average time taken by me to do this operation on a fresh adult skull was half an hour.

Trephining by shell was probably never attempted by Neolithic man in Europe, as our shells are not nearly strong enough to compete with such a substance as flaked flint, of which we possess a remarkable abundance. Primitive man, in the South Pacific islands, most certainly used shell for trephining, shell knives for ordinary use, and shell lancets for opening abscesses. I experimented, however, with an ordinary beach-worn oyster shell, and found I was able to trephine the skull of a 9-months-old infant in about twenty-five minutes, and, to my amazement, with a larger and stronger shell I made a large hole in the somewhat soft skull of a Maori in thirteen and a half minutes. What could not, therefore, be done with some of the powerful shells that are so prevalent among the islands of the South Pacific Ocean?

2. *Boring with Sawing.*

Whether hand flint borers (Fig. 3), hafted flint borers, flint-tipped mechanical borers (Fig. 4), or hafted shark's teeth be used, the method employed is precisely the same. A series of holes, packed as closely together as possible, were bored in the form of a circle. These would number perhaps from fifteen to twenty-two, according to the size of the bone required to be removed. Having done this the bridges of bone between the holes would be cut through either by the side-to-side action of a strong flint flake or by means of a flint saw (Fig. 5). The enclosed rondel of bone was then liberated. This is a very arduous operation, especially if the holes are made by a hand borer (Fig. 3). A hand borer is a flint implement tapering to a point, held either directly in the hand or hafted into a wooden handle and used as if it were a clumsy brad-awl. A quicker and much more effective method of drilling holes was most probably used. The bow drill (Fig. 4) is one of the oldest mechanical contrivances in existence. Canadian Indians, in pre-Columbian days, used one of these, without having any hard material affixed to its end, to make fire by friction against another piece of wood, touchwood or dried leaves being placed in near proximity to catch the spark. With a sharp point of some hard material this contrivance was used for drilling holes. I show you a lantern slide of an Incan skull on which this operation has been performed. I think the regularity of the holes and their proximity to each other will convince you, as it has convinced me, that they have been bored by mechanical means. This operation takes a considerably longer time to perform than one done by scraping, but, of course, a much larger hole can be made. It took me twenty-five minutes to do the first stage alone (drilling the circle of holes) on the cadaver of a male 68 years

of age, and it took me sixty-five minutes to remove a rondel from the skull of a female 40 years of age.

Another method of boring holes, and one which was formerly used in Melanesia, was by shark's teeth. As regards shark's teeth as surgical instruments, I am satisfied that, metal being again excluded, there is no more excellent natural implement for boring holes in bone than a hafted shark's tooth. Its keenly serrated edges and its strong, sharp point make it an instrument invaluable to the primitive surgeon. It moreover possesses a natural flange, which converts it into a trephine of undeniable utility, for the flange is so placed as to prevent the point penetrating too deeply into the thickness of the bone to the wounding of the dura mater. A ring of holes, packed closely together as before, followed by the breaking down of the bridges between them by a scraping and saw-like action of the implement, makes a hole, after removal of the rondel, with which any surgeon may be happily satisfied. Although it took me only twelve minutes to do this operation on the skull of an infant aged 14 months, it took me one and a quarter hours to do the first stage only of the same operation on an adult dry specimen and one and three-quarter hours to do a complete operation on another dry specimen.

3. *The Push-plough Method.*

Coming under neither of the two previous heads (scraping or boring) is, I am convinced, another primitive surgical procedure to which I find no reference in the literature of the subject. Lucas-Championnière does not successfully tackle the problem of how those skulls, found in the French dolmens, exhibiting extremely large trephinations, were operated upon to produce such extraordinary effects. As the edge of the trephine ring shows a partial healing process they cannot be classed as examples of *post-mortem* mutilations of the skull for the purpose of making amulets. In the Museum of the Royal College of Surgeons casts of some of these skulls can be seen, and it fills one with amazement to consider the daring of the primitive surgeon, a feeling which, unfortunately, is mingled with a lack of admiration for his quality of judgement. Lucas-Championnière was inclined to believe that those trephinations that were not done by scraping were done by boring and sawing in the way we have already described. Now no one could possibly imagine that these large trephinations of which I speak were done merely by scraping the bone with a flint scraper; they are much too large for that, consequently it is inferred they were done by the boring method.

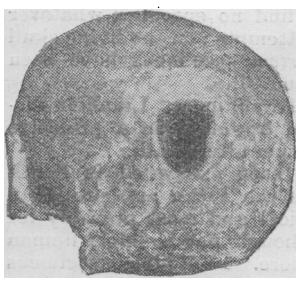

FIG. 11.—The "Edinburgh" prehistoric (?) trephined skull. (Wellcome Hist. Med. Museum.)

It is inconceivable to me that a large boring operation could be performed without there being left behind indisputable evidence of this method having been employed, for when the bridges of bone separating the perforations are cut through a large very ragged ring, comprised of half-holes and half-bridges, remains to tell the tale of how the rondel had been removed. No amount of new bone formation could completely obliterate this. It is possible, I grant, that by extending an already abnormally long operation the surgeon, by a special scraping manipulation, could have done this. But was this likely? In a carefully planned burglary the expert thief thoughtfully leaves behind no trace of his criminal work whereby he may be identified. The Neolithic surgeon was not placed in this position. An operation of this kind would take some hours' hard work, and even if the patient had not become weary of it the surgeon himself would begin to show signs of fatigue and would not be anxious to prolong the proceeding merely for aesthetic reasons.

In the Geological Section of the Museum of Lisbon is a cranium that was taken from the grotto of Casa da Moura at Peniché in Portugal. This grotto contained the remains of no less than 140 individuals of the Neolithic period. This cranium exhibits an unfinished trephination on the left parietal bone, the piece to have been removed being elliptical in shape, 60 mm. long by 20 mm. broad. There are no signs of reparation, which means either that the patient died before the operation was completed or the surgeon gave up either for his own or the patient's sake. I think we may perhaps best describe it as the first stage of another kind of operation. To me it furnishes a valuable clue as to the nature of the finished operation, which would when completed have represented, in my opinion, the method employed by the "French" Neolithic surgeon to bring about those large trephinations of which I have spoken. I think this operation was done by pushing forward a beaked flint implement, used in such a way as to first make a line, then a shallow groove, then a furrow, which, when deepened by continually traversing the same direction, eventually would plough through the diploë and reach the inner table of the skull. When nothing but the vitreous layer remained the rondel would be levered out by a stone or bone elevator (Figs. 8, 9, and 10). Professor Sir Arthur Keith, Conservator of the Museum of the Royal College of Surgeons, agrees with me that this was probably the method employed in removing the great pieces of skull bone which specimens prove were actually accomplished—unhappily, alas! not to the benefit of the patient so treated.

4. *Sawing.*

There is yet another method that was made use of in prehistoric times. We have no proof, however, that this method was employed in Europe, in Africa, or in any of the islands of the Australian Archipelago. It was a very dangerous operation, and there is not on record a single case of success. It consisted in sawing out, with a stone implement, a quadrilateral button of bone, by four straight cuts, leaving on the skull a figure closely resembling a parallelogram with extended sides, such as we were wont to draw as children when playing the game of naughts and crosses (Figs. 12 and 13). If the skull were a level plane there might have been a shadow of a chance of success; but, the skull having a contour of its own, it stands to reason that in order to penetrate the inner table of the skull equally in every direction, which was necessary for the removal of a piece of bone, that part of the skull which was most convex would have to be cut deeper than the level of the extended incisions; thus not only would the dura mater, under the convex part, become damaged, but even the brain substance itself be lacerated to the extent of several millimetres in depth. This operation was performed by the Incan and pre-Incan peoples that inhabited prehistoric Peru. The first specimen displaying this operation, brought to the notice of European surgeons in the year 1867, was discovered by Mr. E. G. Squier (Fig. 12). Both Broca and Nélaton examined this skull, the former giving it as his opinion that the patient lived no longer than seven days after the operation, while the latter put it down as ten. This was judged, of course, by the amount of reparation exhibited by the edges of the aperture. I show you a lantern slide of this skull, as well as of two others which were also excavated in Peru.

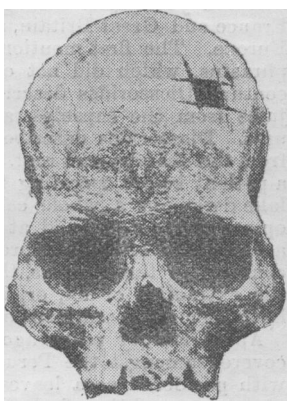

FIG. 12.—Skull of prehistoric Peruvian, discovered by Mr. E. G. Squier in 1867.

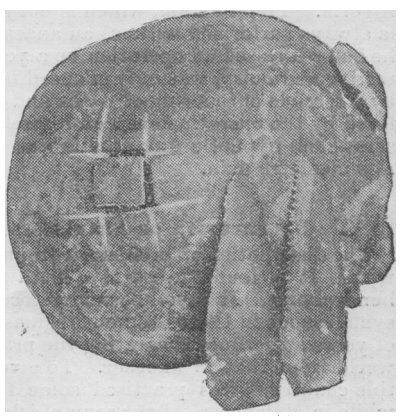

FIG. 13.—Experiment on dry skull, with flint saw, to show how the Incan skull had been trephined.

SHOCK AND ANAESTHETICS.

There is very little shock, I am convinced, with this operation. There is no feeling in bone; if an exposed piece of healthy bone be tapped with a probe the patient does not flinch. Moreover, the scalp has not the keen sensitiveness of other sentient surfaces in the body. I was very fortunate,

during the war, in coming across a Polish doctor from Warsaw who had been doing research work on this very subject in Germany, but had been obliged to take refuge in our country. He would not permit me to make known his name, so I very much regret I cannot give him that personal acknowledgement he deserves in this branch of research. He was working with Dr. Klaatsch of Breslau, who was professor of anthropology in Dresden. He performed operations (primitive and otherwise) on cats and dogs in connexion with trephination (occipital and frontal) to test the amount of shock occurring in connexion with them. Cats and pigs are particularly nervous subjects and show glycosuria on the least provocation of shock. Dogs and rabbits show shock or pain by intestinal contractions; thus shock can be scientifically estimated. The results of the experiments were that no glycosuria occurred from performing the primitive operation of trephination, with flint, on cats, and shock was found to be very slight with the same primitive operation performed on large dogs.

Probably the two earliest discovered anodynes were mandragora and opium, as both these drugs are mentioned in the Papyrus Ebers, which was found near Thebes, and dates from the eighteenth dynasty, about 1500 B.C., some five hundred years after the age of stone culture had closed for France and Great Britain, and indeed for the greater part of Europe. The first mention of opium in Europe is by Theophrastus, which did not occur till 300 B.C. In the first century Dioscorides describes the method of obtaining the juice from the capsules, and Pliny describes its medicinal uses. Dioscorides describes how "Cyprus wine" was made from the mandragora root, and that a dose of it was given to a patient before operating to induce sleep. Among the Swiss lake dwellings a whole cake of the seeds of the garden or opium poppy was found at Robenhausen, but as these seeds are destitute of narcotic properties, which are almost entirely confined to the capsules, the seeds were no doubt pressed for the extraction of oil, or, it has been suggested, they may have been eaten scattered on bread.

About twenty years ago an interesting custom was discovered amongst the Peruvian Indians. They fill a wound with powdered coca leaves, which contain some 9 per cent. of cocaine, and they find after waiting a little while they can do what they like with the part affected without inflicting pain. It is not unlikely that the Incan and pre-Incan races availed themselves of this local anaesthetic when they performed their trephinations, though we have no evidence that this method was used in Europe. Mr. Hilton-Simpson has lately been studying primitive surgery among the Arabs in Algeria. Trephination, which is not at all uncommon there, is always performed without an anaesthetic. He told me that he had witnessed an operation on a young girl, who, becoming restive and noisy, was only silenced into operative subjection by a terrible outpouring of oaths and foul language administered by the operating surgeon himself. I have no doubt that some such hypnotic anaesthetic was employed by the Stone Age medicine man.

DISTRIBUTION OF PREHISTORIC TREPHINATION.

The distribution of prehistoric trephination is *almost* world-wide. It is found in parts of both the eastern and western hemispheres. It must be understood, however, it was never synchronous in these different regions of the earth, thousands of years sometimes separating the practice in one part of the world from that in another. To give just one example. In this country it was practised some four thousand years ago, while in Melanesia—that group of islands situated in Oceania to the east of New Guinea and Australia—primitive trephination is performed to-day with all the simplicity and crudeness it was practised in prehistoric times thousands of years ago. There is no doubt that an ethical need for it arose at a certain time among diverse primitive civilizations when in the state of stone culture, demonology, with special reference to epilepsy, being the primary cause of its being first suggested and then practised. Although migration may have had influence upon this strange custom being disseminated, I do not believe it was answerable for its unified spread, the reason being that it was used in one part of the world for an entirely different reason from what it was in other parts. In one part of Melanesia it is actually employed to promote longevity, handsome youths and beautiful girls being specially singled out for its practice.

In the eastern hemisphere Europe has the distinction of being the leading continent, and in Europe France is the first country, by a long way, to be able to exhibit the largest number of specimens of this unique fetish. Great Britain, Scandinavia (particularly Denmark and Sweden), Germany, Bohemia, Poland and Russia (especially the Caucasian region), Portugal, and Montenegro, have all some skulls to prove its practice in those countries. I know of none that have been yet found in Spain or Italy. Passing over the Mediterranean Sea we find it has been practised in Algeria amongst the Kabyles from very early times, and it is to-day performed by the Arab Shamans, with primitive metal instruments, in the most primitive way, without anaesthetics, without antiseptics, and with the crudest possible dressings. Specimens have been found in the Canary Isles. In Teneriffe von Luschan collected 210 Guanche skulls, ten of which had been trephined. He found others in which the outer table only had been scraped away. Professor Elliot Smith has examined 15,000 skulls from ancient Egypt and Nubia, but tells me he has never found a trephined specimen. I should like to show you a lantern slide of one of them. I have not seen this skull, but the specimen seems to me to so clearly illustrate a depressed fracture that has been treated in this way that I bring before your notice two pictures of it—one a front view and the other a profile one. The Guanches are supposed to have migrated from Egypt, so one would have expected to have found specimens there. It is possible, of course, that the custom was acquired in the Canary Isles after they had been separated from the mainland of north-west Africa.

In Asia, Daghestan can exhibit primitive specimens, and they have also been found in Japan; but the vast area of Asia has hitherto been unexplored from this view-point, and one day, no doubt, other specimens will be unearthed, when new classifications will have to be made.

In the western hemisphere we find no specimen whatever to prove that this operation was attempted on the living skull in North America, but *post-mortem* specimens have been discovered in Michigan, Illinois, and Ohio.

In Mexico, among the ancient Tarahumares, Lumholz discovered two skulls that had been trephined in a primitive manner, one during life and the other after death.

Very many specimens have been excavated in South America, notably in Peru, where the Incan and pre-Incan races practised this art for surgical and most probably for medical and ethical purposes, though not a single human amulet has yet been discovered there. In Bolivia specimens have also been found.

The imaginary line separating the eastern from the western hemisphere cuts through the group of islands in the South Pacific known as Melanesia. In this group it was practised. There are specimens in the Museum of the Royal College of Surgeons from both New Britain (Neu Pommern)—where the operation is performed for fractures only—and New Ireland (Neu Mecklenburg)—where the operation is performed for epilepsy and insanity. In 1874 Ella described an operation that he had himself witnessed in Uvea in the Loyalty group, and as early as 1831 William Ellis described an operation that he had seen performed in the island Bora-Bora in the Society group, over 2,500 miles to the east of the Loyalties. It is still practised in many of these islands, sometimes for fractures of the skull produced by sling-stones or by clubs, and sometimes for epilepsy or other head disorders supposed to be caused by demoniacal possession.

I will finish by showing you the lantern slide of a skull mounted in an elaborate glass-sided reliquary, which is to be seen in the cathedral at Avranches in Brittany. The skull is supposed to have belonged to Saint Aubert, who became Bishop of Avranches in the year 708, founded the church on St. Michael's Mount, and died in 725. This skull has a circular hole in it which was supposed to have been made by the forefinger of the Archangel Michael. If you will examine the hole carefully you will find it is an exact replica in size, shape, and shelving edges of one of those holes I have been showing you to-night—a facsimile, indeed, of a prehistoric trephination; and I suggest to you that if it is not what it purports to be it is a Neolithic trephined skull that must have been found in one of the many dolmens that exist in Brittany, the Carnac region of which has played such an important part in European Neolithic history. The individual in question, therefore, who owned this skull must have lived some three thousand years before Saint Aubert, the learned Bishop of Avranches, was born!

REFERENCE.

The Prehistoric Trephined Skulls of Great Britain, together with a detailed description of the operation probably performed in each case. *Proc. Roy. Soc. Med.* (Hist. Sect.), vol. xiv, No. 10, August, 1921.

FIG. 1.—The "Thames" prehistoric trephined skull. (London Museum.)

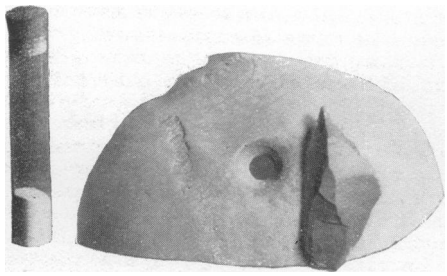

FIG. 2.—Experiment showing method of scraping skull.

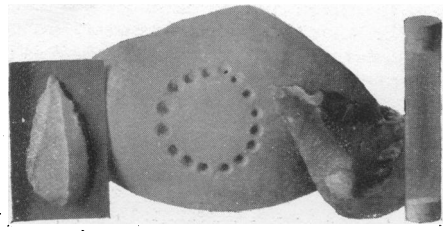

FIG. 3.—Boring and sawing by hand borers.

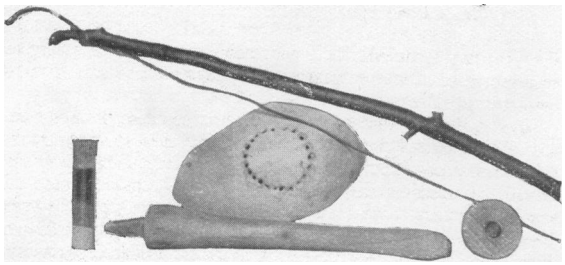

FIG. 4.—Boring and sawing by mechanical borer (bow drill).

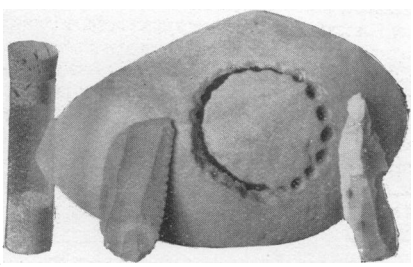

FIG. 5.—Boring and sawing. Final stage of either of the two former methods.

FIG. 6.—Trephined Neolithic frontal bone from a long barrow, near Bisley, Gloucestershire.

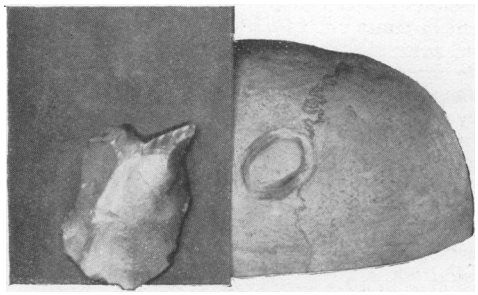

FIG. 7.—Experiment showing how Bisley skull was probably trephined.

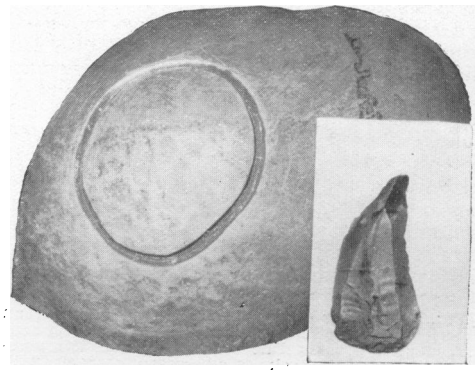

FIG. 8.—Push-plough method. First stage.

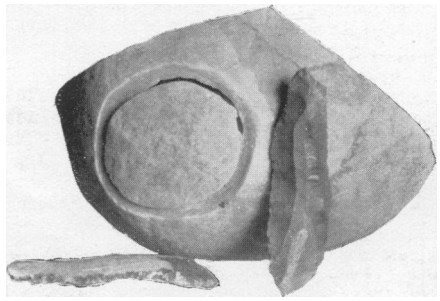

FIG. 9.—Push-plough method. Second stage.

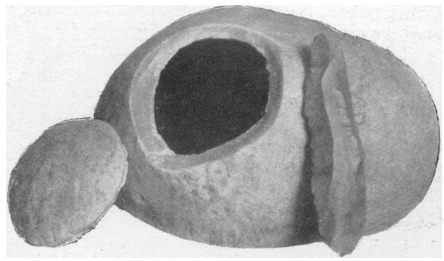

FIG. 10.—Push-plough method. Final stage.